**F’22 ESM 214/L: Biological Waste Treatment**

Lecture BH3526 (Pine) T/R 12:30 – 1:45 pm; Lab R BH2015 (unless noted) 2 ~ 4:50p

Instructor: Trish Holden ([holden@bren.ucsb.edu](mailto:holden@bren.ucsb.edu)) Office: 3508 Bren Hall Tel: 893-3195

Office Hours: T 2 – 5 pm (except: 10/25) or by appt.

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NOTE: Syllabus is living and can change.

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| **Wk** | **Day** | **Topic** |
| 1 | Sept 22  *lab* | Course Intro; Waste; Microbiology & Biogeochemistry |
| *Overview and safety (Room 2015 BH)* |
| 2 | Sept 27 | Global Sanitation; Wastewater Collection; Surveillance |
| Sept 29  *lab* | Wastewater: Characteristics; Overview of Treatment Systems |
| *Exercise 1 (GIS lab; Room 3035 BH): Systems Simulation* |
| 3 | Oct 4 | WW Treatment: Preliminary & Primary Treatment |
| Oct 6  *lab* | Wastewater Treatment: 2nd° (Activated Sludge; Fixed Film; MBRs) |
| *Exercise 2 (Room 2015 BH): Microbiology and microscopy* |
| 4 | Oct 11 | Biological Nutrient Removal (BNR) |
| Oct 13  *lab* | Solids Management: Physical, Biological, Energy, Final Disposal |
| *FIELD TRIP 1: GSD WWTP, Goleta (1:45 pm – 4:30 pm)* |
| 5 | Oct 18 | Disinfection [Lab Exercise 1 due] |
| Oct 20  *lab* | Tertiary Treatment and Reuse |
| *FIELD TRIP 2: Campus Biofilters (1:45 pm – 4:30 pm)* |
| 6 | Oct 25 | *TBD* |
| Oct 27  *lab* | Onsite wastewater treatment  *Meet w/ Prof. Holden (2015 BH) about Paper topics (due)* |
| 7 | Nov 1 | Introduction to Haz waste; Biodegradation and biotransformation  [Lab Exercise 2 due] |
| Nov 3  *lab* | *FIELD TRIP 3: Engel and Gray, Santa Maria*  *(12:30 pm – 4:45 pm)* |
| 8 | Nov 8 | Ex situ Bioremediation |
| Nov 10  *lab* | In situ Natural Attenuation |
| *Exercise 3: Assessing Biostimulation of Hexadecane Mineralization* |
| 9 | Nov 15 | In situ Bioremediation of Hydrocarbons |
| Nov 17  *lab* | In situ Bioremediation of Chlorinated Solvents  *Speed date! Paper title / outline (due) swap & peer feedback* |
| 10 | Nov 22 | In situ Bioremediation: inorganics |
|  | *Thanksgiving Holiday (November 24th)* |
| 11 | Nov 29 | In situ / Ex situ Bioremediation; Course Review  [Lab Exercise 3 due] |
| Dec 1  *lab* | Final Presentations (3526 BH)  *Presentations (due, and presented) 12:30 – 4:30* |

FINAL PAPERS DUE DECEMBER 9th (Friday) COB.

**Course Description:** Concepts and approaches to prevent, correct, and alleviate the effects of environmental pollution using biological processes. Biochemical, ecological, and physiochemical aspects of remediation and mitigation. Assessing and monitoring applicability/efficacy of biological treatment. Natural and engineered methods for adversely affected biological resources.

**Student Learning Outcomes and *Assessments*:**

* Acquire and internalize foundational understanding of biological waste treatment.

*In class discussion, field trips, final presentation and paper*

* Use understanding in relationship to environmental problems including pollution prevention and remediation.

*Invocation of core concepts into exercises, field trips, final paper, and presentation*

* Discover how to find information and resources, for this course and the future.

*Selection of topic for paper and presentation*

*Sourcing for lab reports*

* Communicate the material; write, and present, using your knowledge gained in this course

*Quality of written and oral assignment, based on rubric*

**Course parameters:** Prepare before class meetings: read materials on GauchoSpace and consult other reference materials, as you may need. Class time used for lecture and discussion. Field trips and Lab Exercises to enhance working knowledge of biological treatment and issues; activities are designed to augment the course.

**Requirements and grading:** Class participation (10%), Exercises (3 reports, at 10% each), final paper and presentation (30 and 10%, respectively). Field trip attendance (20%).

**Resources:** GauchoSpace materials, Instructor / TA, UCSB Library; Web of Science

**Books** **(in Bren reading room or UCSB library)** useful to the course material include:

Brock Biology of Microorganisms (any recent edition): a comprehensive advanced text in general microbiology. It is in its 15th edition.

<https://www.pearson.com/us/higher-education/product/Madigan-Brock-Biology-of-Microorganisms-15th-Edition/9780134261928.html>

\*\*Wastewater Engineering: Treatment and Resource Recovery, by Metcalf & Eddy: It is in its 5th edition.

<http://highered.mheducation.com/sites/0073401188/information_center_view0/index.html>

Biodegradation and Bioremediation, by Alexander. 2nd Edition. 1999. <https://www.elsevier.com/books/biodegradation-and-bioremediation/alexander/978-0-12-049861-1>

Bioremediation and Natural Attenuation: Process Fundamentals and Mathematical Models, by Alvarez and Illman. 2005. This is available online, and chapters can be made available during the course.

<http://onlinelibrary.wiley.com/book/10.1002/047173862X>

Standard Methods for the Examination of Water and Wastewater. It is in its 22nd edition. This is the standard for how to characterize wastewater, and water.

<https://www.standardmethods.org/>

**Course policies:** Attending class is encouraged because the course is cumulative, i.e. the material builds and concepts are transferred from the first part of the course to the later parts. Preparing for class will maximize the value of the lectures. Engaging in class is encouraged for your learning; plus, your questions may assist others’ learning. Field trips are arranged for your learning, and you are encouraged to attend all of them. The 3 written Exercise reports are individual: it is your individual work and will be graded accordingly. The final paper and presentation are your works, individually, and will be graded accordingly. [Academic integrity](https://studentconduct.sa.ucsb.edu/academic-integrity) is important. Written communication is an important professional skill in ESM, and the final paper is meant to assist in developing that. Similarly, oral communication practice is gained with you final presentation.